

CARGO TRAILER ANTI-TERRORIST AND ANTI-THEFT SYSTEM

BACKGROUND OF THE INVENTION

Cross-reference to related application

The present application is a continuation-in-part of pending application serial number 09/466,655 filed on December 20, 1999.

Field of the Invention

The present invention is in the field of electro-mechanical devices designed to provide the means to intercept and terminate a terrorist's or renegade's use of cargo trailers (and like vehicles equipped with air brakes) for delivering explosive or hazardous materials to a potential target. A collateral benefit is its capability to deter theft of vehicles with air brakes. More particularly, the present invention is directed to a device or system that remotely locks the brakes of trailers, tractors, fuel tankers, and like vehicles (that are equipped with dual chamber air brakes) with a coded radio signal.

Brief Description of the Prior Art

Cargo-trailers, tractors, fuel tankers and like vehicles are capable of being used to deliver hazardous material for terrorist attacks on vulnerable targets. These vehicles may have been stolen or rented under false pretenses. In the case of trailers and like equipment that do not have their own motive power (engines), compressed air for operating the brake system is supplied through a conduit from the tractor or truck that pulls the trailer. Such trailers and the like towed equipment, as well as many tractors and trucks, are usually equipped with a dual chamber brake system that operates in such a manner that the brakes are automatically locked if pressurized air becomes

1 unavailable. In order to take such a trailer without authorization, that is to steal
2 it when it is parked, the thief typically mates a tractor to the trailer and
3 supplies pressurized air to the dual chamber brake system of the trailer. In
4 other words, by hooking up the thief's tractor's or truck's air pressure conduit
5 to the brake system of the trailer, the thief is able to release the brakes and Pull
6 the trailer with the brakes operating normally. To this date and to the best
7 knowledge of the present inventor, the state-of-the-art has attempted to
8 prevent or discourage the theft of cargo-trailers by providing devices that
9 make it difficult for an unauthorized person to access the trailer's hitch or
10 "fifth wheel" or by providing a keyed cover ("glad hand" cover) that prevents
11 attachment of a pressurized air conduit to the pressurized air inlet of the dual
12 chamber air brake system of the trailer. Experience has shown however, that a
13 determined thief circumvents these devices relatively easily.

14 Additional disclosures pertaining to brake systems, and to means for
15 locking brake systems for various reasons and not necessarily for preventing
16 theft are found in United States Patent Nos. 3,597,016; 3,826,176; 4,007,815;
17 4,014,414; 4,014,579; 4,268,093; 4,273,388; 4,589,704; 4,685,744; 4,873,824;
18 5,402,866; Re. 32,885; Statutory Invention Registration Nos. H117 and H748.
19 United States Patent numbers 4,354,536 and 6,076,385 include additional
20 disclosures pertaining to some type of locking or latching mechanism.

21 Therefore, there is still a serious need in the art for a device or system
22 that renders the dual chamber air brake system of a trailer (or of a tractor)
23 non-operational for unauthorized users. The present invention provides such a
24 system. In addition there is a serious need in the art for means that enables law

1 enforcement and the like to remotely stop a renegade vehicle which is
2 suspected of being loaded with hazardous material on route to a target. The
3 present invention provides such means.

4 SUMMARY OF THE INVENTION

5 It is an object of the present invention to provide a secure and difficult
6 to circumvent remote braking and / or brake locking device for trailers,
7 tractors, or other vehicles equipped with dual chamber air brake systems,
8 which can be initiated (and released) only by an authorized organization or
9 individual.

10 It is another object of the invention to provide means for remotely
11 stopping a trailer, tractor, or other vehicle equipped with dual chamber air
12 brake system by using a coded signal which is available only to law
13 enforcement agencies or authorized organizations or individuals.

14 It is still another object of the present invention to provide the locking
15 device that meets the above-noted objective, and which operates within the
16 interior of the dual chamber air brake system, thereby making it more difficult
17 and time consuming to disassemble or inactivate the locking device and make
18 unauthorized use of the trailer, tractor, or other vehicle equipped with the
19 device less likely.

20 The foregoing and other objects and advantages are attained by a
21 remotely activated device that has means mounted within the interior of the
22 dual chamber brake system which, responsive to a coded signal, vents pressure
23 in the emergency chamber of a dual chamber brake system to automatically
24 apply the brakes thereby bringing a moving vehicle to a stop. This coded

1 signal is ideally made available only to law enforcement agencies and the like.
2 Upon receiving a different coded signal, usually available only to persons who
3 are authorized users of the trailer or vehicle, the device also vents pressure in
4 the emergency chamber and locks the brakes and blocks the brake actuator rod
5 from being retracted into its non-braking operative position by preventing
6 pressurized air from being supplied to the dual chamber brake system of a
7 stopped or parked vehicle. The means for accomplishing these objectives is an
8 electro mechanical device such as a solenoid valve which is remotely actuated
9 by the above-noted coded signals that can only be transmitted by an
10 authorized user or users. This solenoid valve is internally located, preferably at
the air inlet port in the emergency chamber of the dual chamber brake system.

11 The features of the present invention can be best understood together
12 with further objects and advantages by reference to the following description
13 taken in connection with the accompanying drawings wherein like numerals
14 indicate like parts.
15

16 BRIEF DESCRIPTION OF THE DRAWINGS

17 **Figure 1** is a sectional view of a typical dual chamber air brake system
18 in accordance with the state-of-the-art, showing the air brakes in a locked
19 position in a situation when pressurized air is not present in the system.

20 **Figure 2** is a sectional view of a typical dual chamber air brake system
21 in accordance with the state-of-the-art, showing the air brakes in a situation
22 when pressurized air is present in the emergency chamber and the brakes are
23 not applied.

1 **Figure 3** is a sectional view of a typical dual chamber air brake system
2 in accordance with the state-of-the-art, showing the air brakes in a situation
3 when pressurized air is present in the emergency chamber and modulated in
4 the service chamber to partially deploy the brakes.

5 **Figure 4** is a sectional view of a typical dual chamber air brake system
6 in accordance with the state-of-the-art, showing the air brakes in a situation
7 when pressurized air is present in both the emergency and service chamber
8 and the brakes are fully deployed.

9 **Figure 5** is a sectional view of the service brake housing of a dual
10 chamber brake system incorporating the preferred embodiment of the present
11 invention showing the embodiment activated with the brakes in a locked
12 position.
13

14 **Figure 6** is a cross-sectional view taken on lines 6.6 of Figure 5.

15 **Figure 7** is a sectional view of the service brake housing of a dual
16 chamber brake system incorporating the preferred embodiment of the security
17 locking device of the present invention showing the embodiment not activated,
18 with pressurized air supplied to the emergency housing chamber but the
19 brakes not deployed.

20 **Figure 8** is a cross- sectional view taken on lines 8.8 of **Figure 7**.

21 **Figure 9** is an electrical schematic of the preferred embodiment shown
22 in Figure 5 when a moving vehicle is brought to a halt by law enforcement
action.

1 **Figure 10** is an electrical schematic of the preferred embodiment
2 shown in Figure 5 when a moving vehicle is parked and secured against theft
3 by the authorized operator.

4 **Figure 11** is an electrical schematic of the preferred embodiment
5 shown in Figure 7 with the vehicle available for normal operation.

6 DESCRIPTION OF THE PREFERRED EMBODIMENTS

7 The following specification taken in conjunction with the drawings sets
8 forth the preferred embodiment of the present invention. The embodiment of
9 the invention disclosed herein is the best mode contemplated by the inventor
10 for carrying out his invention in a commercial environment, although it should
11 be understood that various modifications can be accomplished within the
12 parameters of the present invention.

13 The present invention is best explained and understood in conjunction
14 with a thorough understanding of the operation of the dual chamber air brake
15 system that is constructed in accordance with the state-of-the-art. For this
16 reason operation of the common state-of-the-art dual chamber air brake
17 system is first explained with reference to **Figures 1** through **4**. The present
18 invention is adapted to operate with such common dual chamber air brake
19 system, with such modifications of the basic system that are required to
20 incorporate into and integrate with it the security locking device of the
21 invention.

22 Referring now to **Figures 1** through **4**, the state-of-the-art dual chamber
23 brake system includes a housing **30** having two chambers with a common
24 bulkhead **32**. The first of the two chambers is the service housing chamber **34**

1 and the second is the emergency housing chamber 36. Each of the two
2 chambers 34 and 36 is divided into two parts by a flexible and stretchable
3 diaphragm, termed the service diaphragm 38 and the emergency diaphragm
4 40, respectively. Each of the two chambers 34 and 36 has a separate inlet port
5 for compressed air, that is, there is a service chamber pressure port 42 and an
6 emergency chamber pressure port 44. A line, conduit or hose (not shown)
7 conducting compressed air can be attached to each port 42 and 44, and is
8 actually attached when the brakes are dynamically operated, that is when the
9 trailer (not shown), truck (not shown), or other vehicle (not shown) having the
10 dual chamber brake system is moved. In the event the vehicle is a trailer (not
11 shown) without its own supply of compressed air then the conduits (not
12 shown) attached to the ports 42 and 44 supply compressed air provided by the
13 truck (not shown), or other towing vehicle (not shown) which pulls the trailer
14 (not shown). In this connection it should be understood that the anti-theft
15 feature of present invention is primarily intended for trailers because these are
16 the most vulnerable for theft, but this feature of the present invention can also
17 find application in any vehicle or equipment that has a dual chamber air brake
18 system and which can be immobilized to prevent or hinder unauthorized
19 removal. The "anti-terrorism" feature of the present invention, that is the
20 feature that allows a moving vehicle to be remotely stopped by a coded signal,
21 is considered equally useful and certainly equally applicable to trailers and to
22 self-propelled vehicles as well.

23 Each of the two chambers 34 and 36 has a vent 46 that permits escape
24 of air from the non-pressurized air space when the space behind the respective

1 diaphragm 38 or 40 is pressurized with compressed air. The vented space in
2 the emergency housing chamber 36 has a pressure plate 48 located between a
3 high spring-rate (powerful) spring 50 and the diaphragm 40. A guide 52 links
4 the movement of the pressure plate 48 in the emergency housing chamber 36
5 to the service diaphragm 38 in the service housing chamber 34 and to a push
6 plate 54 that is located in the service housing chamber 34 between the service
7 diaphragm 38 and the front wall of the service housing 34. The guide 52
8 includes a rod 56 that travels through an opening 58 in the common bulkhead.
9 The rod 56 allows reciprocation of the guide 52 in the longitudinal direction
10 relative to the two housings 34 and 36. A low spring-rate spring 60 is disposed
11 between the push plate 54 and the front wall of the service housing 34. Two
12 bolts 62 that attach the dual chamber brake system to the trailer (not shown),
13 tractor (not shown), or other vehicle (not shown) are shown in the front of the
14 housing 34, although more than two bolts may be used. A removable plug 64
15 is located in the back wall of the emergency housing chamber 36. The purpose
16 of the removable plug 64 is to allow access with a special tool (not shown)
17 into the interior of the emergency housing chamber 36. The low spring-rate
18 spring 60 in the service housing 34 is significantly weaker than the high
19 spring-rate spring 50 in the emergency housing 36. The push plate 54 is
20 connected to a brake actuator rod 66 which passes through an opening 68 in
21 the front wall of the service housing chamber 34. It will be readily understood
22 by those skilled in the art that longitudinal movement of the brake actuator rod
23 66 "controls" the actual brakes of the wheels (not shown); forward movement
24 applies them and rearward movement, that is retraction, releases them.

1 **Figure 1** shows the state-of-the-art dual chamber brake system in a
2 situation when compressed air is not provided to either chamber **34** or **36**. This
3 occurs usually when the trailer (not shown), truck (not shown), or other
4 vehicle (not shown) is parked. In this situation the high spring-rate spring **50**,
5 overcoming the contrary force of the low spring rate spring **60** and
6 compressing the same, pushes the guide **52** forward and thereby forces the
7 push plate **54** and the brake actuator rod **66** forward, fully applying the actual
8 wheel brakes (not shown). In such a situation the wheel brakes are locked and
9 the trailer (not shown), tractor (not shown), or other vehicle (not shown)
10 cannot be moved. However, when compressed air is supplied to the
11 emergency chamber pressure port **44**, as is shown in **Figure 2**, then the high
12 spring-rate spring **50** in the emergency housing chamber **36** is compressed and
13 the low spring rate spring **60** causes the push plate **54** and the brake actuator
14 rod **66** to retract thereby disengaging the wheel brakes (not shown). The trailer
15 (not shown), tractor (not shown), or other vehicle (not shown) can now move
16 normally. **Figure 3** shows the state- of-the-art dual chamber brake system with
17 the brakes applied, as they would be when a driver (not shown) wishes to slow
18 a moving vehicle (not shown). In this situation, due to application of the brake
19 pedal (not shown) a measured pressure of compressed air is applied in the
20 service housing chamber **34** through the service chamber pressure port **42**, the
21 service diaphragm **38** moves forward, the low spring-rate spring **60** is partially
22 compressed, the brake actuator rod **66** is pushed forward by the push plate **54**
23 and the wheel brakes are applied. **Figure 4** shows the situation when the
24 brakes are applied fully by applying full pressure of compressed air in the

1 service housing chamber 34. However, it can be seen that compressed air is
2 still supplied to the emergency housing chamber 36, and the high spring-rate
3 spring 50 is still compressed: the brakes are applied but not "locked" as they
4 would be when the trailer (not shown) is parked without a supply of
5 compressed air to the brakes.

6 **Figures 5 through 11** illustrate the preferred embodiment of the
7 anti-theft security device of the present invention mounted into an otherwise
8 state-of-the-art dual chamber brake system. In this connection it will become
9 apparent and should be understood that the dual chamber brake system is
10 modified to the extent necessary to accommodate and cooperate with the
11 anti-terrorist and anti-theft, brake-locking security device or system.
12 Moreover, while the present specification discloses generic principles and a
13 presently preferred embodiment, several other hardware configurations can be
14 built in light of the present disclosure to restrain the brakes in the locked
15 condition without departing from the spirit of the present invention. Therefore,
16 it is not desired to confine the invention to any of the exact forms shown in
17 this specification, but rather to include them as broadly as is the scope of the
18 invention.

19 In accordance with invention, and in the herein described preferred
20 embodiment, a solenoid valve 100 or the like electro-mechanical valving
21 device is employed to control the flow of pressurized air into and out of the
22 emergency housing chamber 36 to stop a moving vehicle equipped with dual
23 chamber air brakes or to secure such a vehicle against unauthorized removal in
24 a parked condition.

1 The solenoid valve **100** as a component in the apparatus of the present
2 invention is responsive to electrical current (or lack of it) the flow of which is
3 enabled by a receiver decoder **102** that is itself responsive to coded signals,
4 such as electromagnetic or infra red signals akin to the signals that are
5 virtually ubiquitously used in modern times for opening and locking car doors
6 and the like by remote control. The coded signals may be sent by a hand-held
7 "remote control" transmitter, schematically shown in the drawings as **69**, that
8 is ideally possessed only by law enforcement and by persons authorized to
9 operate the trailer (not shown), truck (not shown), or other vehicle (not shown)
10 or to stop its unauthorized operation. When the remote control transmitter is
hand-held then it can be characterized as portable.

11 Alternatively, the coded signals may be supplied to the solenoid valve
12 **100** or like electro mechanically actuated valving device from a transmitter
13 built into the cab of the towing vehicle (not shown) or a hard wire connection
14 (rather than by radiation) in certain of the applications. However, for the
15 anti-terrorism feature of the invention whereby a moving vehicle can be
16 stopped by law enforcement or the like using a coded signal, it is necessary for
17 the receiver decoder **102** to be responsive to a signal originating from a remote
18 source, which may or may not be hand held. Power to operate the solenoid
19 valve **100** or like electro-mechanical valving device can be supplied by
20 batteries in the trailer (not shown), truck (not shown), or other vehicle (not
21 shown). In any event, the solenoid valve **100** or like electro mechanical
22 valving devices and the receiver decoder **102** which are used as components of
23 the apparatus of the present invention and which are responsive to a coded
24

1 signal, are readily available in the state-of-the-art, and need not be described
2 further. In the presently preferred embodiment the receiver decoder 102 is
3 located in a different housing than the solenoid valve 100 or like electro
4 mechanical valving device, and this configuration is shown in the drawing
5 figures. However, it is possible to mount the solenoid valve 100 or like electro
6 mechanical valving device and the ~~solenoid valve~~ receiver decoder 102 January 28 2002
7 such configuration or variations of these configurations are also within the
8 scope of the invention.

9 In the first preferred embodiment, shown in Figures 5 and 6, the
10 normally closed solenoid valve 100 with its coil de-energized vents air from
11 the emergency housing chamber 36 through a flexible vent conduit 106
12 through a duct formed in the guide ~~rod 56~~ 52 January 28 2002
13 un-pressurized portion of the emergency housing chamber 36. The duct and its
14 vent orifice emptying into the un-pressurized portion of the emergency
15 housing chamber 36 bears the reference numeral 108. Air vented through the
16 flexible vent conduit 106 and through the ducts 108 can escape into the
17 environment through the vent 46 in the wall of the emergency housing
18 chamber 36. In addition, in its closed, de-energized position the solenoid valve
19 100 blocks passage of air through the emergency chamber pressure port 44
20 and thereby prevents pressurized air from being re-supplied to the emergency
21 housing chamber 36. When in this condition, the brakes are fully applied and
22 the vehicle is stopped.

23 Figures 9, 10 and 11 depict an electrical circuit which in the herein
24 described preferred embodiment controls the solenoid valve 100 and brings

1 about its closed or open, that is de-energized or energized positions. As it can
2 be seen in these three figures, the electrical circuit consists of two paths (110
3 with a proximity or limit switch 114, and 112 with a first switch 116) in
4 parallel with each other and in series with a third path (120 with a second
5 switch 118) connecting the power source 109 (battery) and the solenoid valve
6 100. The circuit itself is advantageously incorporated in the same housing
7 which includes the receiver decoder 102, or it can be incorporated in the
8 housing of the solenoid valve 100, or in a housing separate (not shown) from
9 either of these devices, and other variations of these configurations are also
10 possible within the scope of the invention. Two of the three switches, 116 and
11 118, of the circuit are opened and/or closed responsive to coded signals sent to
12 and received by the receiver decoder 102. The third switch is a proximity or
13 limit switch 114, also shown in **Figures 5 and 7**, that is normally closed unless
14 opened by contact with the base of guide 52. The function and purpose of this
15 proximity or limit switch 114 are explained below. With all three switches
16 114, 116, and 118 closed as shown in **Figure 11**, the solenoid valve 100 is
17 energized to admit pressurized air into the emergency housing chamber 36
18 compressing the high spring-rate spring 50 placing the brake system in normal
19 operating condition. **Figures 7 and 8** show the brake in this mode.

20 Referring now primarily to **Figure 9** the state of the circuit is shown
21 when the trailer, tractor, or vehicle is stopped by emergency law enforcement
22 or like action. The emergency law enforcement action may be initiated to stop
23 a terrorist vehicle heading toward a restricted area, or a stolen or run-away
24 vehicle refusing to stop when ordered, or such other circumstance that law

1 enforcement deems appropriate. To bring about this status of the circuit and
2 thereby activate the device of the invention in such situation (that is, to stop a
3 moving vehicle), a unique coded signal (first signal or anti-terrorist signal) is
4 transmitted to the receiver decoder 102 which then opens the second switch
5 118 and thereby the electrical circuit, regardless of the condition of switches
6 114 and 116, depriving the solenoid valve 100 of power. The unique coded
7 signal is ideally available only to security and law enforcement agencies or
8 organizations, in other words to persons or organizations who can be trusted
9 and even relied on to stop a moving trailer or vehicle. As it is apparent from
10 the foregoing description and inspection of **Figures 5 and 6**, de-energizing the
11 solenoid valve 100 returns it to the normally closed condition, venting the air
12 from the emergency housing chamber 36 and blocking entry of pressurized air
13 through the emergency chamber pressure port 44 with the result that the
14 brakes of the vehicle are applied fully and the vehicle is brought to an abrupt
15 stop. Another unique coded signal (second signal) may be available to law
16 enforcement to close the second switch 118 to enable the trailer, tractor, or
17 other vehicle to move again, after the danger of terrorist action or like
18 emergency has passed.

19 **Figure 5** shows the status of the brake system when parked, that is, the
20 brakes fully applied and the emergency housing chamber 36 vented. In this
21 parked condition the base of guide 52 is forced against the proximity or limit
22 switch 114 by the expansion of the high spring-rate spring, thereby opening
23 switch 114 and the electrical circuit in one of the parallel paths 110 as shown
24 in **Figure 10**. Thus when the vehicle is parked, and only when it is parked, the

1 anti-theft feature of the invention can be activated by opening the electrical
2 circuit in the second parallel path 112 to de-energize the solenoid valve 100
3 even if the second switch 118 in path 120 is closed. When de-energized, the
4 solenoid valve is closed and pressurized air cannot be supplied to the
5 emergency housing chamber 36. To accomplish this, the driver (not shown) or
6 other authorized individual sends a coded signal (anti-theft or third signal) to
7 the receiver decoder 102 to open the first switch 116 in path 112. This coded
8 signal (anti-theft signal or third signal) is ideally available only to the owner of
9 the trailer, tractor, or other vehicle equipped with the device of the present
10 invention, or to persons authorized by the owner.

11 Still another coded signal, fourth signal (or "to go" signal) ideally
12 available only to the driver or to persons authorized by the owner closes the
13 first switch 116 thereby supplying power to the solenoid valve 100. The circuit
14 in the "to go" operating state of the trailer, tractor, or vehicle is depicted in
15 **Figure 11** and the operating mode of the dual purpose brake system is shown
16 in **Figures 7** and **8**. In this condition the solenoid valve is energized,
17 pressurized air is supplied through the emergency chamber pressure port 44
18 into the emergency housing chamber 36 to compress the high spring-rate
19 spring 50 allowing the low spring-rate spring 60 in the service chamber 34 to
20 expand and release the brake actuating rod 66 from the locked position and
21 allow the braking system to respond to the driver's modulation of the brake
22 pedal (not shown) for normal brake operation.

23 It can be seen from the **Figure 7** that when the trailer, tractor or vehicle
24 equipped with the device of the present invention is in normal operating mode,

1 the base of the guide 52 is not juxtaposed to the proximity or limit switch 114
2 and therefore the proximity or limit switch 114 remains closed. If in this
3 condition of the device, a coded signal such as the anti-theft or third signal (or
4 a signal akin to it which is perceived by the receiver decoder as the anti-theft,
5 or third signal) was inadvertently or accidentally given, then the first switch
6 116 in path 112 would open, but the electrical circuit through the proximity or
7 limit switch 114 in path 110 would still remain closed supplying power to the
8 solenoid valve and thereby preventing unintentional locking of the brakes of
9 the tractor, trailer, or vehicle while it is moving.

10 Those skilled in the art will readily understand that the above
11 description teaches generic principles as well as discloses a presently preferred
12 embodiment, and that several mechanical equivalents of the herein described
13 device may become apparent to those skilled in the art in light of the present
14 disclosure. Similarly, numerous electrical and electronic equivalents of the
15 simple electrical circuit disclosed herein may become readily apparent to those
16 skilled in the art in light of the present disclosure. Nevertheless such
17 mechanical, electrical and electronic equivalents are intended to be within the
18 scope of the present invention. Examples of such equivalent include the
19 employment of a piston in place of the emergency chamber diaphragm, and
20 many variations in other hardware, arrangement of the ports and vents. Other
21 equivalents are using solenoid valves which are normally closed when power
22 is supplied, requiring a rearrangement of the electric circuit, still well within
23 the skill of the ordinary artisan in light of the present disclosure. Nevertheless,
24 the embodiment disclosed herein is presently thought to be the preferred one

1 to manufacture and provide the best security and compatibility with current
2 dual chamber air brake systems in use on a multitude of trailers and vehicles
3 to guard both against unauthorized use (theft) and to enable law enforcement
4 to stop a moving vehicle when the circumstances render this necessary.

5 In one apparent alternative embodiment the electronic circuit may
6 include only the second switch 118 (or an electric or electronic equivalent),
7 and the receiver decoder 102 is responsive only to the first (anti-terrorist)
8 coded signal to open the second switch 118 and thereby stop a moving
9 vehicle, and to a second coded signal which would cause the second switch
10 118 to close. Ideally, these coded signals would be made available only to law
11 enforcement or the like, thereby providing the trailer, tractor or vehicle
12 equipped with a dual chamber brake system an this embodiment of the present
13 invention only with the anti-terrorist feature of the invention.
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